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LAKE TILLERY, MONTGOMERY AND STANLY COUNTIES, NORTH CAROLINA

Pacific Northwest Environmental
Research Laboratory

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June 1975

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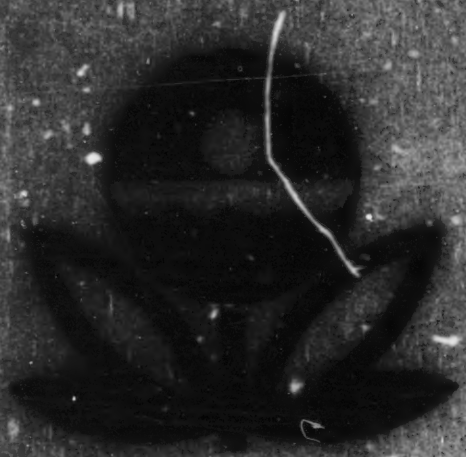

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivded according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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ON
LAKE TILLERY
MONTGOMERY AND STANLY COUNTIES
NORTH CAROLINA

EPA REGION IV

WORKING PAPER No. 390

WITH THE COOPERATION OF THE

NORTH CAROLINA DEPARTMENT OF NATURAL AND ECONOMIC RESOURCES

AND THE

NORTH CAROLINA NATIONAL GUARD

JUNE, 1975

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the North Carolina Department of Natural and Economic Resources for professional involvement and to the North Carolina National Guard for conducting the tributary sampling phase of the Survey.

Lewis R. Martin, Director of the Division of Environmental Management; Darwin L. Coburn, Chief of the Water Quality Section; and Julian R. Taylor, Supervisor of the Monitoring Program Unit; provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

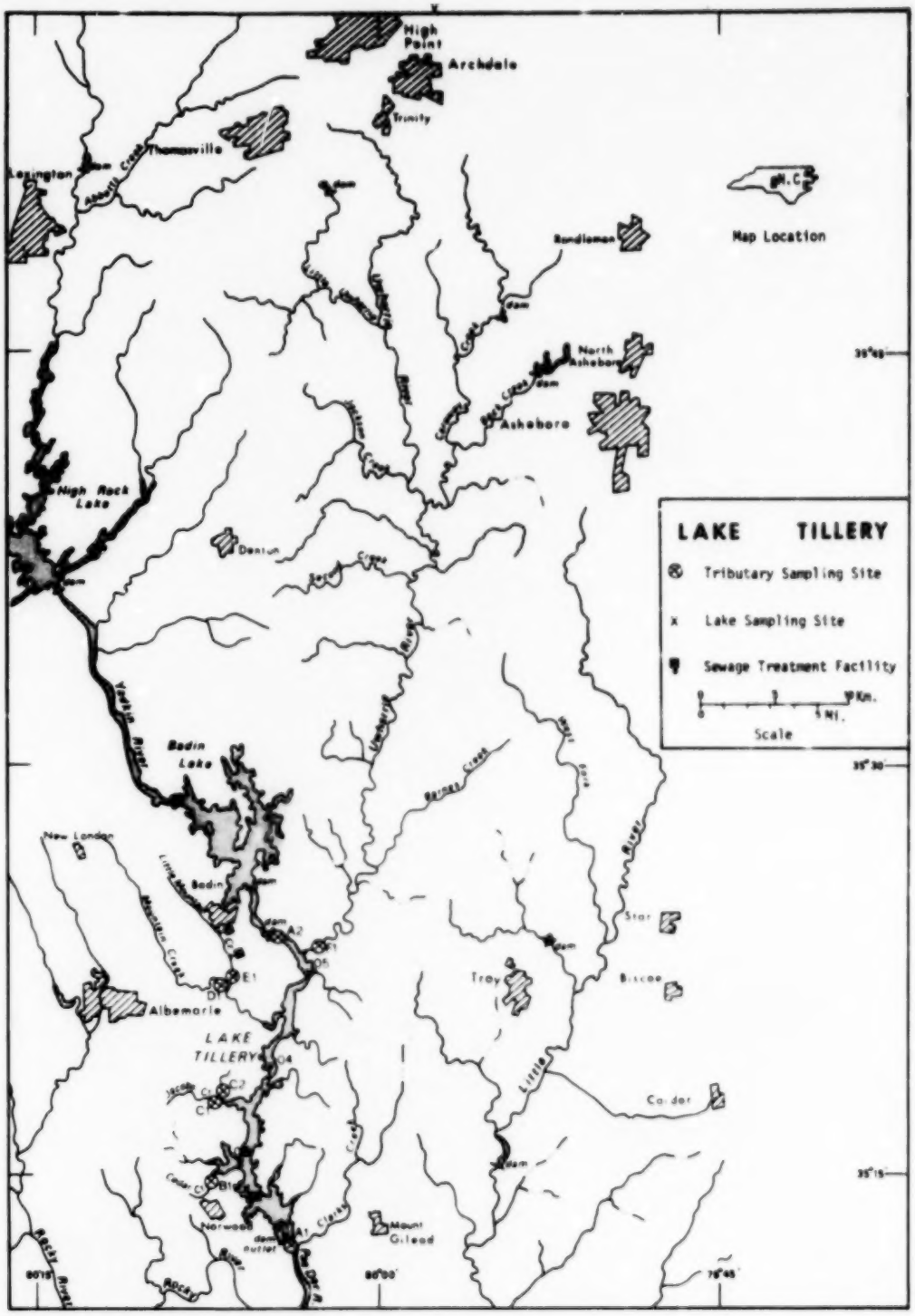
Major General William M. Buck, formerly Adjutant General of North Carolina, and Project Officer Colonel Arthur J. Bouchard, who directed the volunteer efforts of the North Carolina National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF NORTH CAROLINA

LAKE NAME	COUNTY
Badin	Montgomery, Stanly
Blewett Falls	Anson, Richmond
Chatuge	Clay, NC; Towns, GA
Fontana	Graham, Swain
Hickory	Alexander, Caldwell, Catawba
High Rock	Davidson, Rowan
Hiwassee	Cherokee
James	Burke, McDowell
John H. Kerr (Nut Bush Creek)	Granville, Vance, Warren, NC; Halifax, Mecklenburg, VA
Junaluska	Haywood
Lookout Shoals	Alexander, Catawba, Iredell
Mountain Island	Gaston, Mecklenburg
Norman	Catawba, Iredell, Lincoln, Mecklenburg
Rhodhiss	Burke, Caldwell
Santeetlah	Graham
Tillery	Montgomery, Stanly
Waccamaw	Columbus
Waterville	Haywood
Wylie	Gaston, Mecklenburg, NC; York, SC


High Point
Archdale
Trinity
Lexington
Thomasville
Randleman
Map Location
N.C.
North Asheboro
Asheboro
High Rock Lake
Denton
LAKE TILLERY
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Scale
Badin Lake
New London
Badin
Albemarle
Star
Troy
Biscoe
Candor
Norwood
Mount Gilead
35°30
35°15
80°00
79°45

LAKE TILLERY

STORET NO. 3717

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Lake Tillery is eutrophic. However, because this lake has a hydraulic retention time of only 15 days, it more closely resembles a slow moving river; and the term "over-enriched" may be a better description of the condition of this water body.

Lake Tillery ranked eleventh in overall trophic quality when the 16 North Carolina lakes sampled in 1973 were compared using a combination of six parameters*. Nine of the lakes had less median total phosphorus, seven had less and two had the same median dissolved phosphorus, nine had less median inorganic nitrogen, ten had less mean chlorophyll a, and 13 had greater Secchi disc transparency. Dissolved oxygen was depressed with depth at all sampling stations in July, and percent of saturation in the shallowest samples ranged from 53 to 70 in September, except for station 2 where 99% of saturation occurred.

Survey limnologists noted emergent vegetation along the shorelines near stations 1 and 5. Phytoplankton numbers

* See Appendix A.

increased significantly during the summer and fall, and blue-green genera were dominant (see page 8).

B. Rate-Limiting Nutrient:

The algal assay results indicate that Lake Tillery was phosphorus limited at the time the sample was collected. The lake data indicate phosphorus limitation at all sampling times; i.e., the mean inorganic nitrogen to orthophosphorus ratios were 28 to 1 or greater.

C. Nutrient Controllability:

1. Point sources--During the sampling year, the phosphorus contribution of the two wastewater treatment plants at Badin amounted to only 0.5% of the total load reaching Lake Tillery.

The present phosphorus loading rate of 14.92 $g/m^2/yr$ is over five times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic rate (see page 16); and, while Vollenweider's model may not be applicable to water bodies with short hydraulic retention times, the existing trophic condition of Lake Tillery is evidence of excessive nutrient loads.

Control of phosphorus only at the Badin wastewater treatment plants probably would have little effect on the trophic condition of Lake Tillery. However, there are major point sources contributing phosphorus to High Rock Lake* upstream in the Yadkin

* Working Paper No. 381.

River drainage (see map, page v), and it is likely that a significant portion of the phosphorus loads from these sources impacted Lake Tillery and Badin Lake* as well.

Considering only the phosphorus contributions of the point sources impacting High Rock Lake with the 40-kilometer limit of the Survey**, the phosphorus retention in that lake (54%), and the retention in intervening Badin Lake (ca. 22%), it is calculated that 107,000 kg of the 298,000 kg point-source load impacting High Rock Lake also affected Lake Tillery.

It is believed that a high degree of phosphorus control at the major upstream point sources as well as at the immediate point sources would result in a significant improvement in the trophic condition of Lake Tillery, since the primary productivity of the lake is phosphorus limited.

2. Non-point sources--The Yadkin River contributed 92% of the total phosphorus load reaching Lake Tillery during the sampling year. However, on the basis of Survey data and other studies (Anonymous, 1973), much of this load can be attributed to the major upstream point sources as discussed above.

The phosphorus export rate of the Yadkin River was a relatively low 27 kg/km^2 during the sampling year (see page 15). Note, however, if the 107,000 kg of phosphorus calculated

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* Working Paper No. 377.
** See Working Paper No. 175, "...Survey Methods, 1973-1976".

to have been contributed by upstream point sources is subtracted from the Yadkin River load at the Lake Tillery inlet, the export rate is reduced to 17 kg/km^2/yr. This rate is quite comparable to that of the Uwharrie River which is not impacted by point sources as far as is known.

Cedar Creek and Little Mountain Creek had phosphorus export rates of 152 and 124 kg/km^2/yr, respectively. These rates are very high as compared to other Lake Tillery tributaries and may be the result of urban drainage from the communities of Norwood and Badin.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 21.29 kilometers^2.
2. Mean depth: 9.7 meters.
3. Maximum depth: >20.7 meters.
4. Volume: 207 x 10^6 m^3.
5. Mean hydraulic retention time: 15 days (based on outlet flow).

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Yadkin River	10,831.4	141.5
Cedar Creek	8.5	0.1
Jacobs Creek	30.0	0.3
Unnamed Stream (C-2)	4.4	<0.1
Mountain Creek	33.2	0.4
Little Mountain Creek	26.2	0.3
Uwharrie River	976.4	10.1
Minor tributaries & immediate drainage -	158.7	2.1
Totals	12,068.8	154.8

2. Outlet -

Pee Dee River	12,090.1**	154.6

C. Precipitation***:

1. Year of sampling: 135.1 centimeters.
2. Mean annual: 119.0 centimeters.

† Table of metric conversions--Appendix B.
†† Park, 1974.
* For limits of accuracy, see Working Paper No. 175.
** Includes area of lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Lake Tillery was sampled three times during the open-water season of 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from five stations on the lake and from a number of depths at each station (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first visit, two 18.9-liter depth-integrated samples were composited for algal assays (stations 1, 2, and 3 were combined, and stations 4 and 5 were combined). Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 20.7 meters at station 1, 13.7 meters at station 2, 14.6 meters at station 3, 10.7 meters at station 4, and 5.2 meters at station 5.

The lake sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR LAKE TILLERY
STORET CODE 3717

PARAMETER	1ST SAMPLING (3/22/73) 5 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/ 7/73) 5 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/20/73) 5 SITES RANGE	MEAN	MEDIAN
TEMP (C)	11.7 - 13.9	12.9	12.8	23.7 - 29.8	26.6	26.5	25.1 - 27.5	26.2	26.3
DISS OXY (MG/L)	10.2 - 11.0	10.6	10.6	1.4 - 9.2	4.3	3.6	3.4 - 7.8	5.0	4.7
CNDCTVY (MCHOMO)	65. - 70.	68.	69.	63. - 70.	69.	70.	62. - 78.	69.	69.
PH (STAND UNITS)	7.1 - 7.4	7.3	7.3	6.4 - 8.3	7.1	6.7	6.4 - 6.9	6.6	6.6
TOT ALK (MG/L)	13. - 23.	18.	17.	28. - 40.	35.	35.	13. - 24.	18.	17.
TOT P (MG/L)	0.079 - 0.094	0.088	0.087	0.025 - 0.075	0.041	0.040	0.014 - 0.031	0.018	0.017
ORTHO P (MG/L)	0.021 - 0.028	0.024	0.024	0.004 - 0.014	0.007	0.007	0.005 - 0.011	0.008	0.008
NO2+NO3 (MG/L)	0.280 - 0.630	0.496	0.495	0.140 - 0.470	0.354	0.400	0.150 - 0.280	0.209	0.190
AMMONIA (MG/L)	0.140 - 0.210	0.174	0.180	0.040 - 0.240	0.093	0.090	0.040 - 0.160	0.069	0.060
KJEL N (MG/L)	0.300 - 0.600	0.405	0.400	0.300 - 0.800	0.504	0.400	0.300 - 1.400	0.559	0.500
INORG N (MG/L)	0.440 - 0.760	0.676	0.680	0.190 - 0.630	0.448	0.480	0.210 - 0.350	0.278	0.275
TOTAL N (MG/L)	0.580 - 1.110	0.903	0.890	0.560 - 1.270	0.859	0.790	0.550 - 1.590	0.768	0.665
CHLRPYL A (UG/L)	2.6 - 3.5	3.0	3.0	5.2 - 8.4	6.9	7.6	6.1 - 12.7	10.6	12.0
SECCHI (METERS)	0.4 - 0.5	0.4	0.4	0.5 - 1.1	0.8	0.9	0.9 - 1.3	1.2	1.2

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal units per ml
03/22/73	1. Blue-green filaments	115
	2. Synedra	38
	3. Lyngbya	38
	4. Ankistrodesmus	19
	5. Cryptomonas	10
	Other genera	40
	Total	260
07/07/73	1. Raphidiopsis	3,040
	2. Oscillatoria	883
	3. Coccoid cells	602
	4. Synedra	508
	5. Microcystis	470
	Other genera	1,368
	Total	6,871
09/20/73	1. Raphidiopsis	12,078
	2. Oscillatoria	664
	3. Flagellates	313
	4. Synedra	156
	5. Microcystis	117
	Other genera	352
	Total	13,680

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
03/22/73	01	2.7
	02	2.6
	03	3.1
	04	3.0
	05	3.5
07/07/73	01	5.2
	02	7.6
	03	8.4
	04	5.5
	05	7.9
09/20-21/73	01	9.5
	02	12.0
	03	12.7
	04	12.6
	05	6.1

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. Stations 1, 2, and 3 -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.024	0.526	4.4
0.050 P	0.074	0.526	12.4
0.050 P + 1.0 N	0.074	1.526	28.0
1.0 N	0.024	1.526	4.2

b. Stations 4 and 5 -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.030	0.550	11.9
0.050 P	0.080	0.550	13.9
0.050 P + 1.0 N	0.080	1.550	25.1
1.0 N	0.030	1.550	9.8

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential primary productivity of Lake Tillery was moderately high (stations 1, 2, and 3) to high (stations 4 and 5) at the time the samples were collected. Also, the increases in yield when orthophosphorus was added, indicates limitation by phosphorus, although the greatest increases occurred when nitrogen and phosphorus were added together. Note that nitrogen alone did not result in significantly increased yields in either assay.

The lake data further indicate phosphorus limitation. At all sampling times and in both assay sample groups, the mean inorganic nitrogen to orthophosphorus ratios were 28 to 1 or greater.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the North Carolina National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of January and February when two samples were collected. Sampling was begun in March, 1973, and was completed in February, 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the North Carolina District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads shown are those measured minus point-source loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the means of the nutrient exports, in $kg/km^2/year$, at stations C-1, C-2, and D-1 and multiplying the means by the ZZ area in km^2.

The operator of the Alcoa #1 (Badin) wastewater treatment plant provided monthly effluent samples and corresponding flow data. The operator of the Alcoa #2 (Badin) wastewater treatment plant also

* See Working Paper No. 175.

participated; however, corresponding flow data were not provided, and nutrient loads were estimated at 1.134 kg P and 3.401 kg N/capita/year.

A. Waste Sources:

1. Known municipal* -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Alcoa #1	2,300	trickling filter	1,604.8	Little Mountain Creek
Alcoa #2	200	trickling filter	238.5	Little Mountain Creek

2. Known industrial - None

* Barden, 1973.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Yadkin River	292,395	92.0
Cedar Creek	1,295	0.4
Jacobs Creek	500	0.2
Unnamed Stream (C-2)	85	<0.1
Mountain Creek	500	0.2
Little Mountain Creek	3,255	1.0
Uwharrie River	14,880	4.7
b. Minor tributaries & immediate drainage (non-point load) -	2,700	0.9
c. Known municipal STP's -		
Alcoa #1	1,330	0.4
Alcoa #2	225	0.1
d. Septic tanks* -	65	<0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	375	0.1
Total	317,605	100.0

2. Outputs -

Lake outlet - Pee Dee River 264,015

3. Net annual P accumulation - 53,590 kg.

* Estimate based on 145 lakeshore dwellings and one campground; see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Yadkin River	4,433,205	91.1
Cedar Creek	6,485	0.1
Jacobs Creek	11,740	0.3
Unnamed Stream (C-2)	1,820	<0.1
Mountain Creek	15,930	0.3
Little Mountain Creek	12,145	0.3
Uwharrie River	288,440	5.9
b. Minor tributaries & immediate drainage (non-point load) -	67,925	1.4
c. Known municipal STP's -		
Alcoa #1	3,970	0.1
Alcoa #2	680	<0.1
d. Septic tanks* -	2,350	<0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	22,985	0.5
Total	4,867,675	100.0

2. Outputs -

Lake outlet - Pee Dee River 5,244,970

3. Net annual N loss - 377,295 kg.

* Estimate based on 145 lakeshore dwellings and one campground; see Working Paper No. 175.
** See Working Paper No. 175.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Yadkin River	27	409
Cedar Creek	152	763
Jacobs Creek	17	391
Unnamed Stream (C-2)	19	414
Mountain Creek	15	480
Little Mountain Creek	124	464
Uwharrie River	15	295

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" rate is the rate at which the receiving water would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	14.92	2.52	228.6	loss*

Vollenweider loading rates for phosphorus ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Lake Tillery:

"Dangerous" (eutrophic rate)	2.92
"Permissible" (oligotrophic rate)	1.46

* There was an apparent loss of nitrogen during the sampling year. This may have been due to nitrogen fixation in the lake, solubilization of previously sedimented nitrogen, recharge with nitrogen-rich ground water, unknown or unsampled point sources directly impacting the lake, or insufficient outlet sampling in relation to the short hydraulic retention time of the lake. Whatever the cause, a similar loss of nitrogen has occurred at Shagawa Lake, Minnesota, which has been intensively studied by EPA's National Eutrophication and Lake Restoration Branch (Malueg, et al., 1975).

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VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	3719	LAKE WACCAMAW	534
2	3716	SANTEELAH LAKE	446
3	3711	MOUNTAIN ISLAND LAKE	419
4	3707	HIWASSEE LAKE	414
5	3704	FONTANA LAKE	392
6	3713	LAKE NORMAN	346
7	3708	LAKE JAMES	334
8	3710	LOOKOUT SHOALS	327
9	3715	RHODHISS LAKE	296
10	3705	LAKE HICKORY	283
11	3717	LAKE TILLERY	246
12	3709	LAKE JUNALUSKA	220
13	3702	BLEWETT FALLS LAKE	200
14	3718	WATERVILLE RESERVOIR	140
15	3701	BADIN LAKE	124
16	3706	HIGH ROCK LAKE	76

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
3701	BADIN LAKE	0.042	0.680	466.750	7.190	14.900	0.012
3702	BLEWETT FALLS LAKE	0.090	0.655	476.889	4.167	10.800	0.034
3704	FONTANA LAKE	0.011	0.550	392.650	3.438	14.900	0.007
3705	LAKE HICKORY	0.047	0.320	461.000	7.275	13.400	0.008
3706	HIGH ROCK LAKE	0.090	0.580	477.454	14.283	14.800	0.017
3707	HIWASSEE LAKE	0.015	0.240	420.555	5.678	14.200	0.007
3708	LAKE JAMES	0.020	0.160	428.866	7.660	14.800	0.006
3709	LAKE JUNALUSKA	0.031	0.560	462.000	7.233	14.200	0.009
3710	LOOKOUT SHOALS	0.026	0.370	459.167	4.200	13.800	0.008
3711	MOUNTAIN ISLAND LAKE	0.018	0.270	462.000	5.580	12.800	0.005
3713	LAKE NORMAN	0.019	0.330	446.667	5.807	14.800	0.005
3715	RHODHISS LAKE	0.061	0.305	462.111	3.578	13.600	0.019
3716	SANTEELAH LAKE	0.011	0.160	366.400	5.360	14.800	0.006
3717	LAKE TILLERY	0.040	0.470	466.600	6.827	13.600	0.008
3718	WATERVILLE RESERVOIR	0.103	0.860	468.333	3.817	14.400	0.041
3719	LAKE WACCAMAW	0.018	0.120	455.667	3.583	9.800	0.004

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
3701	BADIN LAKE	33 (5)	7 (1)	27 (4)	27 (4)	3 (0)	27 (4)	124
3702	BLEWETT FALLS LAKE	7 (1)	13 (2)	7 (1)	73 (11)	93 (14)	7 (1)	200
3704	FONTANA LAKE	100 (15)	33 (5)	93 (14)	100 (15)	3 (0)	63 (9)	392
3705	LAKE HICKORY	27 (4)	60 (9)	53 (8)	13 (2)	80 (12)	50 (7)	283
3706	HIGH ROCK LAKE	13 (2)	20 (3)	0 (0)	0 (0)	23 (3)	20 (3)	76
3707	HIWASSEE LAKE	87 (13)	80 (12)	87 (13)	47 (7)	50 (7)	63 (9)	414
3708	LAKE JAMES	60 (9)	87 (13)	80 (12)	7 (1)	23 (2)	77 (11)	334
3709	LAKE JUNALUSKA	47 (7)	27 (4)	43 (6)	20 (3)	50 (7)	33 (5)	220
3710	LOOKOUT SHOALS	53 (8)	47 (7)	60 (9)	67 (10)	60 (9)	40 (6)	327
3711	MOUNTAIN ISLAND LAKE	73 (11)	73 (11)	43 (6)	53 (8)	87 (13)	90 (13)	419
3713	LAKE NORMAN	67 (10)	53 (8)	73 (11)	40 (6)	23 (2)	90 (13)	346
3715	RHODHISS LAKE	20 (3)	67 (10)	33 (5)	93 (14)	70 (10)	13 (2)	296
3716	SANTEELAH LAKE	93 (14)	93 (14)	100 (15)	60 (9)	23 (2)	77 (11)	446
3717	LAKE TILLERY	40 (6)	40 (6)	13 (2)	33 (5)	70 (10)	50 (7)	246
3718	WATERVILLE RESERVOIR	0 (0)	0 (0)	20 (3)	80 (12)	40 (6)	0 (0)	140
3719	LAKE WACCAMAW	80 (12)	100 (15)	67 (10)	87 (13)	100 (15)	100 (15)	534

APPENDIX B

CONVERSIONS FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR NORTH CAROLINA 10/21/75

LAKE CODE 3717 LAKE TILLERY RESERVOIR

TOTAL DRAINAGE AREA OF LAKE(SQ MI) 4668.00

TRIBUTARY	SUB-DRAINAGE AREA(SQ MI)	NORMALIZED FLOWS(CFS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3717A1	4668.00	6760.00	7780.00	8240.00	7300.00	5280.00	4290.00	3990.00	4390.00	4240.00	4240.00	4120.00	5050.00	5489.70
3717A2	4182.00	6080.00	6840.00	7240.00	6620.00	4960.00	4060.00	3710.00	4105.00	3970.00	4080.00	3870.00	4630.00	4996.15
3717B1	3.30	4.80	7.60	6.40	4.90	1.80	1.70	2.00	2.00	1.40	1.90	1.60	2.90	3.22
3717C1	11.60	17.00	27.00	22.00	17.00	6.30	6.00	7.00	7.20	4.80	6.70	5.60	10.00	11.29
3717C2	1.70	2.40	3.90	3.30	2.50	0.90	0.90	1.00	1.10	0.70	1.00	0.80	1.50	1.65
3717D1	12.80	18.00	29.00	25.00	19.00	6.90	6.70	7.70	7.90	5.20	7.40	6.10	11.00	12.39
3717E1	10.10	15.00	23.00	19.80	15.00	5.50	5.30	6.10	6.30	4.10	5.90	4.80	8.80	9.82
3717F1	377.00	530.00	780.00	750.00	521.00	263.00	176.00	208.00	219.00	220.00	173.00	198.00	329.00	355.29
3717ZZ	69.50	102.00	160.00	185.00	105.00	38.00	37.00	43.00	44.00	35.00	41.00	34.00	62.00	73.36

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 4668.00
SUM OF SUB-DRAINAGE AREAS = 4667.99

TOTAL FLOW IN = 65722.19
TOTAL FLOW OUT = 65680.00

MEAN MONTHLY FLOWS AND DAILY FLOWS(CFS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3717A1	3	73	11900.00	25	8750.00				
	4	73	12600.00	29	17400.00				
	5	73	8800.00						
	6	73	7000.00	3	6950.00				
	7	73	5300.00	8	96.00				
	8	73	6090.00	5	8100.00				
	9	73	3150.00	1	10.00				
	10	73	3650.00	14	10.00				
	11	73	4050.00	4	1570.00				
	12	73	6360.00	2	115.00				
	1	74	10900.00	6	6150.00	18	7990.00		
	2	74	10000.00	3	12600.00	14	7900.00		
	3	74	6370.00	3	7060.00				
3717A2	3	73	10900.00	25	7950.00				
	4	73	11300.00	29	28700.00				
	5	73	8400.00						
	6	73	6700.00	3	8040.00				
	7	73	5200.00	8	20.00				
	8	73	5900.00	5	8940.00				
	9	73	3070.00	9	20.00				
	10	73	3450.00	14	20.00				
	11	73	3800.00	4	1540.00				
	12	73	6120.00	2	20.00				
	1	74	10100.00	6	8290.00	18	7580.00		
	2	74	8890.00	3	9220.00	14	8800.00		
	3	74	6100.00	3	7460.00				

TRIBUTARY FLOW INFORMATION FOR NORTH CAROLINA 10/21/75

LAKE CODE 3717 LAKE TILLERY RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CFS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
371781	3	73	7.80	25	3.50				
	4	73	11.00	29	1.40				
	5	73	0.70						
	6	73	1.30	3	0.30				
	7	73	6.50	8	0.40				
	8	73	0.50	5	0.50				
	9	73	0.10	9	0.10				
	10	73	0.10	14	0.10				
	11	73	0.10	4	0.10				
	12	73	2.70	2	0.10				
	1	74	6.60	6	3.70	18	1.00		
	2	74	10.00	3	40.00	14	3.10		
	3	74	2.00	3	1.50				
3717C1	3	73	27.00	25	12.00				
	4	73	37.00	29	5.00				
	5	73	3.00						
	6	73	4.50	3	0.90				
	7	73	22.00	8	1.40				
	8	73	1.70	5	2.00				
	9	73	0.30	9	0.30				
	10	73	0.10	14	0.10				
	11	73	0.10	4	0.10				
	12	73	9.50	2	0.10				
	1	74	23.00	6	13.00	18	3.50		
	2	74	36.00	3	140.00	14	11.00		
	3	74	7.10	3	5.20				
3717C2	3	73	4.00	25	1.00				
	4	73	5.40	29	0.70				
	5	73	0.50						
	6	73	0.70	3	0.10				
	7	73	3.30	8	0.20				
	8	73	0.30	5	0.30				
	9	73	0.10	9	0.0				
	10	73	0.0	14	0.0				
	11	73	0.0	4	0.0				
	12	73	1.40	2	0.0				
	1	74	3.40	6	1.90	18	0.50		
	2	74	5.20	3	21.00	14	1.60		
	3	74	1.00	3	0.80				
371701	3	73	38.00	25	14.00				
	4	73	41.00	29	5.50				
	5	73	3.50						
	6	73	5.00	3	1.00				
	7	73	25.00	8	1.50				
	8	73	2.00	5	0.10				
	9	73	0.40	9	0.10				
	10	73	0.20	14	0.10				
	11	73	0.10	4	0.10				
	12	73	10.00	2	0.10				
	1	74	26.00	6	14.00	18	3.90		
	2	74	48.00	3	160.00	14	12.00		
	3	74	7.80	3	5.80				

TRIBUTARY FLOW INFORMATION FOR NORTH CAROLINA 10/21/75

LAKE CODE 3717 LAKE TILLERY RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CFS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3717E1	3	73	24.00	25	11.00				
	4	73	33.00	29	4.30				
	5	73	2.10						
	6	73	4.00	3	0.80				
	7	73	20.00	8	1.20				
	8	73	1.60	5	1.70				
	9	73	0.30	9	0.20				
	10	73	0.10	14	0.10				
	11	73	0.10	4	0.10				
	12	73	8.30	2	0.10				
	1	74	20.00	6	11.00	18	3.00		
	2	74	31.00	3	125.00	14	9.40		
	3	74	6.20	3	4.50				
3717F1	3	73	800.00	25	505.00				
	4	73	1000.00	29	520.00				
	5	73	360.00						
	6	73	350.00	3	210.00				
	7	73	245.00	8	200.00				
	8	73	180.00	5	330.00				
	9	73	75.00	9	46.00				
	10	73	30.00	14	30.00				
	11	73	50.00	4	39.00				
	12	73	190.00	2	68.00				
	1	74	620.00	6	290.00	18	170.00		
	2	74	680.00	3	2270.00	14	340.00		
	3	74	350.00	3	300.00				
3717ZZ	3	73	140.00						
	4	73	180.00						
	5	73	15.00						
	6	73	24.00						
	7	73	60.00						
	8	73	10.00						
	9	73	2.00						
	10	73	0.80						
	11	73	5.50						
	12	73	42.00						
	1	74	135.00						
	2	74	160.00						
	3	74	42.00						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/10/20

371701
35 12 38.0 080 04 12.0
LAKE TILLERY
37167 NORTH CAROLINA

11EPALES
3

2111202
0055 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/03/22	09	50 0000	12.5		18	70	7.30	23	0.180	0.500	0.500	0.025
	09	50 0004	12.5	10.6		70	7.40	22	0.170	0.300	0.490	0.025
	09	50 0015	12.5	10.6		70	7.40	15	0.180	0.300	0.510	0.020
	09	50 0030	12.4	11.0		70	7.40	18	0.180	0.300	0.510	0.022
	09	50 0050	12.4	10.6		70	7.40	17	0.180	0.400	0.510	0.022
73/07/07	12	50 0000	29.0		36	70	8.20	30	0.060	0.800	0.140	0.004
	12	50 0006	28.8	3.8		65	7.40	32	0.050	0.600	0.140	0.006
	12	50 0015	26.7	8.2		65	6.60	32	0.130	0.800	0.360	0.008
	12	50 0030	25.2	2.4		70	6.40	30	0.130	0.700	0.440	0.011
	12	50 0050	24.4	2.2		70	6.40	31	0.240	0.800	0.390	0.010
	12	50 0068	23.7	1.4		70	6.40	28	0.220	0.800	0.390	0.014
73/09/20	13	40 0000	27.1		46	75	6.40	22	0.100	1.300	0.220	0.011
	13	40 0005	27.0	4.2		75	6.40	20	0.080	0.500	0.190	0.010
	13	40 0015	26.9	4.6		75	6.40	20	0.070	0.400	0.170	0.007
	13	40 0025	26.9	4.8		75	6.60	20	0.070	0.500	0.170	0.008
	13	40 0045	26.9	4.6		76	6.50	21	0.080	0.500	0.170	0.009
	13	40 0065	26.7	3.4		78	6.50	23	0.160	0.600	0.170	0.010

STORET RETRIEVAL DATE 75/10/20

371701
35 12 38.0 080 04 12.0
LAKE TILLERY
37167 NORTH CAROLINA

11EPALES 2111202
3 0055 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/03/22	09 50	0000	0.091	2.7
	09 50	0004	0.088	
	09 50	0015	0.091	
	09 50	0030	0.079	
	09 50	0050	0.085	
73/07/07	12 50	0000	0.025	5.2
	12 50	0006	0.028	
	12 50	0015	0.030	
	12 50	0030	0.038	
	12 50	0050	0.075	
	12 50	0068	0.074	
73/09/20	13 40	0000	0.017	9.5
	13 40	0005	0.015	
	13 40	0015	0.031	
	13 40	0025	0.018	
	13 40	0045	0.017	
	13 40	0065	0.020	

STORET RETRIEVAL DATE 75/10/20

371702
35 14 20.0 080 05 46.0
LAKE TILLERY
37167 NORTH CAROLINA

11EPALES
3

2111202
0050 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/03/22	11 00	0000	12.8									
	11 00	0004	12.8	10.6	17	70	7.20	23	0.180	0.400	0.490	0.025
	11 00	0015	12.7	10.8		69	7.30	22	0.170	0.400	0.490	0.025
	11 00	0025	12.7	10.4		69	7.40	21	0.190	0.400	0.490	0.025
	11 00	0045	11.7	10.2		69	7.40	23	0.160	0.400	0.490	0.025
73/07/07	13 30	0000	29.4			69	7.30	23	0.150	0.300	0.490	0.025
	13 30	0006	29.0	8.6	36	70	8.30	36	0.040	0.300	0.430	0.021
	13 30	0015	26.5	4.0		65	7.60	35	0.040	0.400	0.164	0.045
	13 30	0028	25.3	3.2		70	7.50	34	0.100	0.400	0.190	0.007
	13 30	0039	25.0	3.0		70	6.60	31	0.120	0.300	0.450	0.013
73/09/20	14 17	0000	27.5			70	8.10	29	0.140	0.800	0.470	0.050
	14 17	0005	26.9	7.8	46	74	6.40	22	0.070	0.700	0.460	0.000
	14 17	0015	26.8	4.4		74	6.40	21	0.060	1.100	0.180	0.009
	14 17	0025	26.8	4.0		75	6.40	22	0.060	0.600	0.160	0.000
	14 17	0042	26.7	5.4		74	6.40	24	0.070	0.600	0.160	0.004
						73	6.40	17	0.060	0.500	0.160	0.000
										0.400	0.150	0.005

STORET RETRIEVAL DATE 75/10/20

371702
35 14 20.0 080 05 46.0
LAKE TILLERY
37167 NORTH CAROLINA

11EPALES 2111202
3 0050 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/03/22	11 00	0000	0.091	2.6
	11 00	0004	0.084	
	11 00	0015	0.085	
	11 00	0025	0.085	
	11 00	0045	0.099	
73/07/07	13 30	0000	0.033	7.6
	13 30	0006	0.036	
	13 30	0015	0.044	
	13 30	0024	0.043	
	13 30	0039	0.042	
73/09/20	14 17	0000	0.016	12.0
	14 17	0005	0.017	
	14 17	0015	0.017	
	14 17	0025	0.017	
	14 17	0042	0.018	

STORET RETRIEVAL DATE 75/10/20

371703
35 15 10.0 080 05 57.0
LAKE TILLERY
37167 NORTH CAROLINA

11EPALES
3

2111202
0051 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/03/22	15 15	0000	13.2		16	70	7.30	15	0.210	0.400	0.550	0.028
	15 15	0005	13.2	10.6		65	7.20	14	0.200	0.300	0.550	0.023
	15 15	0015	13.1	10.4		65	7.30	16	0.160	0.300	0.280	0.022
	15 15	0030	12.9	10.4		65	7.30	16	0.180	0.400	0.500	0.027
	15 15	0047	11.8	10.8		70	7.30	15	0.140	0.500	0.540	0.021
73/07/07	14 00	0000	29.8		42	68	8.20	39	0.040	0.500	0.190	0.004
	14 00	0006	29.4	9.2		63	7.70	37	0.040	0.500	0.200	0.005
	14 00	0015	26.7	4.0		70	6.70	35	0.090	0.300	0.330	0.006
	14 00	0030	25.1	3.2		70	6.60	37	0.100	0.300	0.470	0.008
	14 00	0046	24.5	2.4		70	6.60	34	0.130	0.300	0.440	0.008
73/09/21	09 20	0000	25.9	5.6	52	65	6.90	16	0.090	1.400	0.190	0.008
	09 20	0015	25.9	5.8		62	6.90	16	0.060	0.400	0.170	0.007
	09 20	0030	25.8	5.4		63	6.80	13	0.050	0.400	0.200	0.007
	09 20	0048	25.5	4.2		65	6.70	16	0.060	0.400	0.260	0.006

STORET RETRIEVAL DATE 75/10/20

371703
35 15 10.0 080 05 57.0
LAKE TILLERY
37167 NORTH CAROLINA

11EPALES 2111202
3 0051 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/03/22	15 15	0000	0.086	3.1
	15 15	0005	0.080	
	15 15	0015	0.080	
	15 15	0030	0.083	
	15 15	0047	0.092	
73/07/07	14 00	0000	0.032	8.4
	14 00	0006	0.034	
	14 00	0015	0.028	
	14 00	0030	0.042	
	14 00	0046	0.048	
73/09/21	09 20	0000	0.017	12.7
	09 20	0015	0.014	
	09 20	0030	0.016	
	09 20	0048	0.024	

STORET RETRIEVAL DATE 75/10/20

371704
35 19 00.0 080 04 55.0
LAKE TILLERY
37167 NORTH CAROLINA

11EPALES
3

2111202
0040 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/03/22	16 00	0000	13.4		18	70	7.20	17	0.170	0.600	0.510	0.024
	16 00	0005	13.4	10.6		65	7.30	17	0.180	0.400	0.470	0.022
	16 00	0015	13.4	10.6		65	7.30	16	0.180	0.400	0.490	0.023
	16 00	0035	13.4	10.7		65	7.40	16	0.180	0.400	0.490	0.022
73/07/07	14 30	0000	27.3		18	70	6.80	37	0.050	0.400	0.390	0.005
	14 30	0006	26.5	6.6		70	6.90	38	0.050	0.400	0.400	0.006
	14 30	0015	25.9	2.0		70	6.60	38	0.090	0.300	0.460	0.008
	14 30	0033	25.0	3.4		70	6.70	40	0.100	0.300	0.450	0.008
73/09/21	09 50	0000	25.3	5.4	37	64	6.60	16	0.060	0.600	0.260	0.007
	09 50	0010	25.3	5.0		64	6.70	16	0.050	0.300	0.260	0.006
	09 50	0020	25.3	5.0		64	6.80	15	0.040	0.300	0.260	0.008
	09 50	0035	25.2	4.4		64	6.70	14	0.050	0.300	0.260	0.011

STORET RETRIEVAL DATE 75/10/20

371704
35 19 00.0 080 04 55.0
LAKE TILLERY
37167 NORTH CAROLINA

11EPALES 2111202
3 0040 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/03/22	16 00	0000	0.086	3.0
	16 00	0005	0.088	
	16 00	0015	0.087	
	16 00	0035	0.090	
73/07/07	14 30	0000	0.045	5.5
	14 30	0006	0.043	
	14 30	0015	0.039	
	14 30	0033	0.046	
73/09/21	09 50	0000	0.021	12.6
	09 50	0010	0.018	
	09 50	0020	0.019	
	09 50	0035	0.019	

STORET RETRIEVAL DATE 75/10/20

371705
35 2' 20.0 080 03 05.0
LAKE TILLERY
37167 NORTH CAROLINA

11EPALES
3

2111202
0020 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 N02&N03 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/03/22	16	30 0000	13.9		17	70	7.10	14	0.200	0.600	0.500	0.026
	16	30 0004	13.9	10.8		65	7.20	13	0.190	0.500	0.490	0.025
	16	30 0015	13.9	10.8		65	7.20	13	0.180	0.500	0.490	0.024
73/07/07	14	45 0000	26.4		24	70	6.70	40	0.070	0.400	0.410	0.005
	14	45 0006	26.5	5.0		70	6.70	40	0.060	0.400	0.410	0.006
	14	45 0013	26.2	5.0		70	6.70	39	0.060	0.400	0.410	0.004
73/09/21	10	20 0000	25.1	4.4	48	63	6.70	13	0.070	0.600	0.280	0.007
	10	20 0010	25.1	6.2		63	6.70	13	0.050	0.300	0.280	0.005
	10	20 0017	25.1	4.6		63	6.60	14	0.060	0.300	0.280	0.006

STORET RETRIEVAL DATE 75/10/20

371705
35 22 20.0 080 03 05.0
LAKE TILLERY
37167 NORTH CAROLINA

11EPALES 2111202
3 0020 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/03/27	16 30	0000	0.091	3.5
	16 30	0004	0.094	
	16 30	0015	0.093	
73/07/07	14 45	0000	0.040	7.9
	14 45	0006	0.037	
	14 45	0013	0.040	
73/09/21	10 20	0000	0.014	6.1
	10 20	0010	0.016	
	10 20	0017	0.014	

APPENDIX E

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 75/10/20

3717A1 LS3717A1
35 12 30.0 080 04 00.0
PEE DEE RIVER
37075 7.5 MI GILEAD W
O/LAKE TILLERY (RESVR)
NORWOOD DAM 2.25 MI ESE OF TOWN NORWOOD
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/25	11 50		0.460	0.370	0.110	0.042	0.070
73/04/29	09 30		0.410	0.420	0.084	0.027	0.065
73/06/03	08 30		0.315	0.340	0.053	0.011	0.035
73/07/08	09 45		0.075	1.600	0.033	0.005K	0.020
73/08/05	09 15		0.220	0.770	0.026	0.005K	0.022
73/09/01	09 45		0.399	1.500	0.069	0.005K	0.040
73/10/14	09 35		0.220	0.500	0.126	0.015	0.040
73/11/04	10 30		0.231	0.450	0.046	0.011	0.030
73/12/02	10 00		0.260	0.200	0.034	0.005K	0.005K
74/01/06	10 00		0.510	0.900	0.124	0.024	0.080
74/01/18	09 10		0.570	0.800	0.100	0.024	0.085
74/02/03	10 20		0.520	0.300	0.060	0.030	0.090
74/02/14	10 25		0.510	1.000	0.050	0.030	0.105
74/03/03	10 15		0.500	0.500	0.040	0.025	0.065

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/10/20

3717A2 LS3717A2
35 23 30.0 080 04 30.0
YADKIN RIVER
37 15 ALBEMARLE
1/LAKE TILLERY (RESVR)
FALLS DAM 2.3 MI SE OF BADIN
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/25	11 00		0.440	0.520	0.132	0.042	0.110
73/04/29	07 20		0.410	0.490	0.097	0.026	0.065
73/06/03	08 38		0.315	0.400	0.088	0.014	0.060
73/07/08	09 05		0.399	0.350	0.038	0.006	0.040
73/08/05	09 50		0.260	0.750	0.082	0.006	0.030
73/09/09	09 00		0.336	0.750	0.019	0.005K	0.025
73/10/14	09 00		0.231	1.150	0.310	0.009	0.030
73/11/04	09 00		0.280	0.600	0.092	0.015	0.030
73/12/02	08 55		0.330	0.300	0.044	0.005K	0.020
74/01/06	09 05		0.528	0.600	0.140	0.024	0.090
74/01/18	10 40		0.560	0.600	0.136	0.032	0.105
74/02/03	09 00		0.510	0.400	0.090	0.035	0.115
74/02/14	10 30		0.504	0.400	0.075	0.040	0.110
74/03/03	08 45		0.470	0.800	0.070	0.030	0.080

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/10/20

371781 LS371781
35 14 30.0 080 07 30.0
CEDAR CREEK
37 7.5 MT GILEAD W
T/LAKE TILLERY (RESVR)
RD 1740 XING 1.4 MI N JCT US 52
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/25	11 08		0.520	0.340	0.073	0.060	0.115
73/04/29	08 33		0.550	0.860	0.198	0.230	0.450
73/06/03	09 45		0.810	2.800	0.510	0.430	0.760
73/07/08	08 15		0.022	3.570	0.038	0.082	0.560
73/08/05	08 30		0.100	1.760	0.019	0.260	0.600
73/09/09	08 15		0.052	2.400	0.017	0.037	0.465
73/10/14	08 40		0.029	1.750	0.176	0.023	0.200
73/11/04	09 30		0.014	4.100	0.170	0.042	0.330
73/12/02	08 45		0.036	2.500	0.060	0.064	0.290
74/01/06	09 00		0.820	1.400	0.192	0.340	0.620
74/01/18	09 30		0.580	2.600	1.200	0.660	1.200
74/02/03	08 45		0.660	0.700	0.045	0.055	0.155
74/02/14	10 50		0.780	0.900	0.095	0.085	0.160
74/03/03	08 45		0.570	0.900	0.115	0.210	0.380

STORET RETRIEVAL DATE 75/10/20

3717C1 LS3717C1
35 17 30.0 080 07 00.0
JACOBS CREEK
37 15 ALBEMARLE
T/LAKE TILLERY (RESVR
RD 1740 BRDG 5 MI ESE OF ALBEMARLE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/25	10 55		0.220	0.260	0.048	0.019	0.025
73/04/29	08 45		0.094	0.330	0.044	0.014	0.030
73/06/03	09 30		0.410	0.440	0.077	0.018	0.039
73/07/08	08 40		0.320	0.820	0.026	0.015	0.025
73/08/05	08 50		0.700	1.150	0.080	0.115	0.195
73/08/04	08 40		0.063	0.250	0.011	0.033	0.055
73/10/14	08 50		0.011	1.400	0.097	0.009	0.035
73/11/04	09 00		0.010K	0.500	0.020	0.012	0.012
73/12/02	09 15		0.020	2.050	0.072	0.008	0.022
74/01/06	09 15		1.680	0.700	0.036	0.024	0.045
74/01/18	09 40		0.526	1.000	0.070	0.025	0.045
74/02/03	09 15		0.850	0.600	0.025	0.050	0.108
74/02/14	11 00		0.850	0.500	0.020	0.015	0.035
74/03/03	09 00		0.400	0.500	0.040	0.007	0.025

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/10/20

3717C2
35 17 10.0 080 06 55.0
UNNAMED STREAM
37 STANLEY CO HWY
T/LAKE TILLERY
RD 1740 BRDG 4.5 MI SE OF ALBEMARLE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/25	10 35		0.032	0.140	0.050	0.014	0.014
73/04/29	09 00		0.011	0.200	0.017	0.008	0.020
73/06/03	09 15		0.300	0.440	0.063	0.018	0.045
73/07/08	09 00		0.240	3.300	0.480	0.052	0.230
73/08/05	09 10		0.100	1.050	0.040	0.031	0.070
74/01/06	09 30		1.600	0.500	0.044	0.008	0.015
74/01/18	09 50		0.430	0.800	0.060	0.008	0.010
74/02/03	09 36		0.760	0.400	0.010	0.060	0.090
74/02/14	11 05		0.504	0.200	0.020	0.010	0.025
74/03/03	09 15		0.504	0.600	0.085	0.025	0.065

STORET RETRIEVAL DATE 75/10/20

371701 LS371701
35 22 00.0 080 07 00.0
MOUNTAIN CREEK
37 15 ALBEMARLE
T/LAKE TILLERY (RESVR)
RD 1720 BRDG 3 MI S OF TOWNOF BADIN
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/25	11 30		0.500	0.340	0.032	0.010	0.020
73/04/29	07 50		0.231	0.350	0.022	0.008	0.025
73/06/03	09 20		0.560	0.380	0.044	0.017	0.050
73/07/08	09 55		0.770	1.470	0.050	0.013	0.025
73/08/05			0.270	1.260	0.054	0.029	0.055
73/09/09	09 47		0.032	1.800	0.110	0.011	0.065
73/10/14	10 00		0.066	0.900	0.130	0.016	0.060
73/11/04	10 05		0.019	1.200	0.096	0.025	0.065
74/01/06	09 50		1.600	0.500	0.034	0.012	0.030
74/01/18	10 15		0.890	0.600	0.038	0.006	0.015
74/02/03	09 45		0.650	1.000	0.052	0.035	0.090
74/02/14	09 45		1.180	1.100	0.400	0.030	0.070
74/03/03	09 50		0.528	1.000	0.045	0.005K	0.020

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/10/20

3717E1 LS3717E1
35 17 00.0 080 06 30.0
LITTLE MOUNTAIN CREEK
37 15 ALBEMARLE
T/LAKE TILLERY (RESVR)
RD 1798 BRDG W OF ENTER TO MORROW MT ST
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/25	11 15		0.440	0.220	0.027	0.038	0.075
73/04/29	07 45		0.670	0.580	0.092	0.168	0.230
73/06/03	09 10		1.560	0.580	0.073	0.760	0.880
73/07/08	09 40		1.800	0.540	0.050	0.690	0.738
73/08/05	09 35		1.000	1.000	0.080	0.430	0.540
73/09/09	09 36		1.280	1.150	0.092	0.580	0.630
73/10/14	09 30		1.760	1.800	0.270	1.000	1.100
73/11/04	09 30		1.080	0.800	0.105	1.060	1.150
73/12/02	09 45		1.520	0.900	0.032	1.040	1.200
74/01/06	09 25		1.260	0.400	0.320	0.108	0.145
74/01/18	10 20		1.680	0.900	0.100	0.352	0.460
74/02/03	09 15		0.560	0.800	0.130	0.045	0.140
74/02/14	10 00		1.090	0.600	0.175	0.075	0.135
74/03/03	09 15		0.820	0.700	0.015	0.180	0.270

STORET RETRIEVAL DATE 75/10/20

3717F1 LS3717F1
35 23 30.0 080 03 00.0
UHHARRIE RIVER
37 15 ALBEMARLE
T/LAKE TILLERY (RESVR)
BANK SAMPLE AT END OF CO RD1151
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/25	10 45		0.168	0.250	0.052	0.021	0.035
73/04/29	10 30		0.210	0.540	0.029	0.025	0.075
73/06/03	10 40		0.390	0.500	0.075	0.012	0.060
73/07/08	07 00		0.390	0.400	0.058	0.012	0.060
73/08/05	10 05		0.210	0.880	0.105	0.021	0.055
73/09/04	10 05		0.198	0.540	0.016	0.006	0.055
73/10/14	09 45		0.180	1.200	0.094	0.010	0.045
73/11/04	10 10		0.399	0.225	0.039	0.020	0.035
73/12/02	10 10		0.288	1.100	0.084	0.005K	0.035
74/01/06	10 30		0.520	0.700	0.036	0.016	0.055
74/01/14	10 05		0.310	0.600	0.060	0.012	0.030
74/02/03	11 05		0.200	0.700	0.025	0.015	0.045
74/02/14	11 00		0.360	0.400	0.040	0.015	0.040
74/03/03	10 50		0.176	0.800	0.025	0.005	0.030

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/10/20

3717EA TF3717EA P002380
35 22 30.0 080 09 25.0
ALCOA EAST PLANT (BADIN)
37075 IS ALBEMARLE
T/LAKE TILLERY
LITTLE MOUNTAIN CREEK
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00619 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/06/26	10	30							
CP(T)-			4.800	2.100	1.160	2.800	3.600	0.480	0.333
73/06/26	15	00							
73/07/25	10	30							
CP(T)-			4.500	4.300	1.900	2.800	3.600	0.430	0.300
73/07/25	15	00							
73/08/24	09	30							
CP(T)-			5.500	3.300	1.450	4.200	5.000	0.325	0.323
73/08/24	14	30							
73/10/01	09	30							
CP(T)-			6.500	4.900	1.470	3.360	3.450	0.325	0.229
73/10/01	14	30							
73/10/25	09	00							
CP(T)-			6.900	2.600	1.470	3.900	4.200	0.275	0.220
73/10/25	14	00							
73/11/30	09	30							
CP(T)-			3.020	5.700	2.730	0.004	4.400	0.260	0.210
73/11/30	14	30							
74/01/03	09	30							
CP(T)-			3.300	1.300	0.430	1.040	1.350	1.000	0.524
74/01/03	14	30							
74/01/28	09	30							
CP(T)-			6.000	1.000K	0.060	1.240	1.400	1.000	0.606
74/01/28	14	30							
74/02/27	09	30							
CP(T)-			4.700	1.600	0.093	1.400	1.550	0.600	0.716
74/02/27	14	30							
74/04/01	09	30							
CP(T)-			3.960	1.000K	0.110	1.150	1.650	1.000	0.384
74/04/01	14	30							
74/04/30	09	30							
CP(T)-			4.400	2.100	0.690	2.500	2.800	0.550	0.725
74/04/30	14	30							
74/05/28	09	30							
CP(T)-			3.900	1.500	0.096	1.000	1.175	0.950	0.442
74/05/28	14	30							

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/10/20

3717EW IF3717EW P000200
35 25 20.0 080 06 37.0
ALCOA WEST PLANT (BADIN)
37 15 ALBEMARLE
T/LAKE TILLERY
LITTLE MOUNTAIN CREEK
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50050 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/06/26	10 30								
CP(T)-			3.300	1.400	0.195	1.100	1.350		
73/06/26	15 00								
73/07/25	10 30								
CP(T)-			4.200	0.130	0.110	1.320	1.500		
73/07/25	15 00								
73/08/24	09 30								
CP(T)-			5.800	0.350	0.236	1.980	2.100		
73/08/24	14 30								
73/10/01	09 30								
CP(T)-			5.400	1.550	0.150	1.547	1.550		
73/10/01	14 30								
73/10/25	09 00								
CP(T)-			4.700	0.120	0.120	1.600	1.720		
73/10/25	14 00								
73/11/30	09 30								
CP(T)-			3.800	0.750	0.160		0.930		
73/11/30	14 30								
74/01/03	09 30								
CP(T)-			2.100	0.710	0.190	0.650	0.730		
74/01/03	14 30								
74/01/28	09 30								
CP(T)-			5.200	1.000K	0.040K	0.530	0.530		
74/01/28	14 30								
74/02/27	09 30								
CP(T)-			3.000	2.900	0.058		0.590		
74/02/27	14 30								
74/04/01	09 30								
CP(T)-			1.500	1.000K	0.190	0.520	0.590		
74/04/01	14 30								
74/04/30	09 30								
CP(T)-			5.800	1.000	0.150	1.150	1.240		
74/04/30	14 30								
74/05/28	09 30								
CP(T)-			2.600	1.900	0.210	0.375	0.490		
74/05/28	14 30								

K VALUE KNOWN TO BE
LESS THAN INDICATED